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RESEARCH TO PRACTICE- IMPLEMENTING SIGN-INFUSED INTERVENTION AS A NOVICE CLINICIAN

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Masters of Arts

in

The Department of Communication Sciences and Disorders

by
Loren Stoller
B.S., Florida State University, 2018
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ABSTRACT

Speech-Language Pathologists often infuse manual signs into oral language interventions for children with various communication disorders. The current study was designed to learn more about sign-infused language intervention by examining one novice clinician's use of signs during oral language intervention with a child diagnosed as a late talker. The researcher was the clinician, and while a novice interventionist, she was proficient in American Sign Language (ASL) and had five years of experience using ASL with others. The child was 26 months of age at the start of the study, and data collection included three pre-intervention sessions, 12 intervention sessions, and three post-intervention sessions. Analyses focused on the researcher and child's frequencies and types of sign, ratios of signs to words, and changes in spoken language behavior.

Results showed that the researcher produced all of the planned signs at high frequencies during the intervention, and she also produced a number of spontaneous signs, although these decreased as the sessions progressed. The frequency of her sign use increased as the sessions progressed and by the end, her sign to word ratio was close to 80% as recommended in the literature. Also, of those planned, verbs were signed most frequently, followed by nouns and prepositions. When the researcher's spoken language behaviors were examined across sessions and by utterances with and without signs, no differences were detected.

By comparison, the child signed WANT only once during the intervention and post-intervention sessions, but her spoken language significantly increased as the sessions progressed. From the pre- to post-sessions, the child increased her number of utterances, mean length of utterance (MLU), total words, and total different words.

The findings indicate that novice clinicians who know sign can implement a sign-infused language intervention with late talkers and that this intervention can lead to positive gains in the child's language abilities. Clinicians can use the findings of the current study to show parents the benefits of signs for increasing late talkers' spoken language development.

CHAPTER 1. INTRODUCTION

Baby sign is commonly regarded as an aid to children's speech and language development. In support of this statement, one can find the promotion of baby sign in books written for parents (e.g., *Baby Signs: How to talk with Your Baby Before Your Baby Can Talk*, Acredolo & Goodwyn, 2009) and on multiple on-line parenting websites (e.g., *The Benefits of Baby Sign Language*, <https://www.motherlove.com/blogs/all/the-benefits-of-baby-sign-language>). These resources typically discuss the benefits of baby sign and offer parents directions and examples on how to introduce baby signs to their children. In addition, these resources often posit that teaching signs help children communicate their needs and thoughts earlier than with oral communication and lead to higher levels of intelligence, speech, language, and literacy. Finally, signs are often discussed as helping children reduce frustration, tantrums or emotional outbursts, and increasing parent/child bonding and the child's feelings of self-esteem, satisfaction, and accomplishment.

Unfortunately, the evidence supporting the benefits of baby sign with children who have typical speech, language, and hearing abilities is limited. For example, Nelson, White, and Grewe (2012) attempted to find empirical evidence in support of baby sign for children with typical speech and language development. As part of their efforts, they scoured journal articles, books, newspaper articles, presentations, and opinions by experts. Based on their review, they concluded that there was a positive correlation with sign teaching and speech and language development in children, but the evidence was primarily anecdotal. In fact, of the 82 pieces of evidence they found across 33 different websites, ~90% reflected opinions or lacked actual data to support the author(s)' claims.

For children with various communication disorders, however, teaching signs as a method of intervention is supported by evidence and widely used by Speech-Language Pathologists (SLPs). For example, SLPs often use signs as part of an augmentative or alternative communication (AAC) approach for children with severe speech and/or expressive language disorders (Beukelman & Mirenda, 2013), and significant findings for increased growth in expressive communication have been found with these approaches (Ronski et al., 2010).

For children with less severe communication disorders, SLPs may also pair signs with oral language as part of a “total communication” or “simultaneous communication” program (Center for Early Literacy Learning, 2011). Recently, Wright, Kaiser, Reikowsky, and Roberts (2012) developed and tested the efficacy of infusing sign into an oral communication intervention. In this study, the intervention was administered individually to four children with Down syndrome for 10 weeks, twice weekly. Results showed positive gains in the children’s use of signs, spoken words, and the time they spent in joint attention with the clinician during play.

The current study was designed to learn more about the use of signs by SLPs who use a sign-infused oral communication intervention. To do this, a sign-infused intervention was created for a child who presented as a late talker. Late talkers are children who present with limited speech and expressive language despite having typical hearing, hearing parents, age-appropriate receptive language abilities, and age-appropriate cognitive abilities (Oller, Eilers, Neal, & Schwartz, 1999). Given the difficulty, time, and expense of conducting a well-designed intervention study, the goal of the current study was not to evaluate the benefits of sign-infused therapy. Instead, the study sought to describe a novice clinician’s attempt to incorporate signs into a sign-infused intervention to better understand the types and frequencies of the clinician’s signs and the effect(s) of the signs on the clinician and child during and after the intervention as

compared to the pre-treatment sessions. As background for the study, the literature review is divided into four sections. First, the researcher will describe the types of children with communication disorders who are most likely to benefit from the use of sign within intervention. Then, the type of sign that is typically used by SLPs within interventions will be described and contrasted with other types of signed systems. Next, the researcher will review studies that have used sign as an AAC therapy approach for children with severe communication disorders. Finally, the researcher will review the recent study by Wright et al. (2012), because the sign-infused intervention used in the current study was designed after their methods. The literature review ends with a summary of the literature and the research questions that guided the study.

Review of Literature

Children Most Likely to Benefit from Sign within an Intervention

Down syndrome (DS). DS is a genetic disorder that causes developmental and cognitive impairments in language and intellect (McDuffie, Thurman, Channell, & Abbeduto, 2017). Due to low speech intelligibility, motor developmental delays, and physiological and anatomical differences, children with DS and their parents are often encouraged to use gestures and signs to facilitate communication. Signs are often taught in natural language environments, such as play or other daily activities (e.g., mealtime, bath time, etc.). Children with DS are encouraged to use signs to increase their expressive language (Wright et al., 2012). As an example, the book *Let's Sign and Down Syndrome* (Smith & Uttley, 2008) was written with the purpose of teaching parents how to teach individuals with DS to use signs and possibly some grammar from British Sign Language (BSL). Within a published parent testimonial, McAuliffe (2008) also discusses the benefits of sign language for his daughter with DS. At 1 year of age, his daughter was exposed to sign by her SLP, and according to McAuliffe, his daughter quickly began using the

signs with her SLP and family. At age four, his daughter transitioned to speech as her primary communication, but according to McAulffie, use of sign was key to helping her develop her expressive language skills. As will be discussed in the next section, at least one study by Wright et al. (2012) has also examined the effects of a sign-infused intervention for children with DS, and results were positive.

Childhood Apraxia of Speech (CAS). CAS is a neurological disorder that is typically explored as a potential medical condition when children are late to talk and show oral motor inconsistencies. Children with CAS demonstrate impairments in muscle movements that affect articulatory movements of speech, and they often present with a smaller inventory of vocalizations and words (Shakibayi, Zarifian, & Zanjari, 2019). Given this, sign is often recommended for children with CAS. In addition, there are many online parent testimonials about how sign language helped their children with CAS. These testimonials highlight the importance of sign in helping their children communicate basic needs and develop a symbolic communication system, with additional benefits including a reduction in child frustration. Testimonials also note that signs can be used to control a child's rate of speech and as cues/kinesthetic reinforcement for a child's articulation of phonemes, words, and utterances.

In support of sign-infused therapy for children with CAS, Tierney et al. (2016) conducted a single case study of a three-year-old male child with CAS. The child's mother began using Signed Exact English (SEE) with her child in hopes of strengthening his vocabulary and expressive language at 14 months of age, and before he was diagnosed with CAS. Given that the child presented with such a strong preference for sign that when he began therapy, the intervention chosen was sign-infused with intensive speech motor planning. The sign portion of the therapy consisted of using signs to elicit speech. According to Tierney et al. (2016), the sign-

infused therapy and oral motor exercises resulted in the client demonstrating improvements in speech intelligibility, which eventually led to the child's cessation of the signs.

Millar, Light, and Schlosser (2006) also conducted a review of 23 studies with the aim of determining the effect of manual signs and/or nonelectronic systems within an AAC therapy approach on the speech production of individuals with developmental disabilities. Of the six studies selected for review, there were 27 participants ranging from 2 to 60 years. Of these 27 participants, 89% showed improvements from either AAC, manual signs or nonelectronic aided systems.

Autism Spectrum Disorder (ASD). Autism is a developmental disorder that is typically diagnosed early in childhood. Children with ASD often present social/pragmatic deficits, speech and language impairments, repetitive behaviors, and overall daily functional difficulties (Slaughter 2019). The literature is mixed regarding the usefulness of sign for children with ASD. Kurt (2011) conducted a study implementing a parallel treatments design to compare the effects of two approaches for increasing the receptive language skills of two male children with ASD. The two approaches were: verbal instructions only and verbal instructions combined with simple gestures and signs. The findings showed that the sign-infused teaching approach led to greater receptive language skills for the two children. In addition, Tincani (2004) used an alternating treatments design to examine the effects of a signed treatment and a picture-based treatment for two children, aged 5 to 6, with ASD. The picture-based treatment involved the Picture Exchange Communication System (PECS; Bondy & Frost, 2002). When comparing the treatments, the author found that the sign language treatment created more vocalizations in both children with ASD.

Schlosser and Wendt (2008) completed a systematic review of treatment studies for children with ASD or pervasive developmental disorder. Their review identified nine single-subject experiments with 27 participants and two group studies with 98 participants. The nine studies included treatments with sign and treatments with other AAC devices. Some of the dependent measures that were examined within these studies included the children's mean length of utterance (MLU), word imitation, words elicited, and word approximations. Based on their review, Schlosser and Wendt concluded that AAC interventions (including those with sign) do not hinder the speech production of children with ASD and these treatments may facilitate children's production of speech. However, they also concluded that across studies, the gains documented in the children's speech production were modest.

Finally, Couper et al., (2014) compared the effects of offering children manual signs, pictures from PECS, and speech-generating devices (SGD) in a study of nine children with ASD. Using a non-concurrent, multiple-baseline design across participants and an alternating treatments design, they reported that all children were able to use the three AAC options, but eight of the nine children preferred the SGD option.

Late Talkers. Children whose language development is below age expectancies with no other diagnosis of a disability or developmental delay are known to have late language emergence. Moreover, when these children's receptive language abilities are appropriate for their age, they may be referred to by clinicians as late talkers. According to Horowitz et al. (2003) and Rescorla and Achenbach (2002), 13.5% of children, aged 18- to 23- months, and 16-17.5% of children, aged 30-36-month, present a language profile that can be classified with the label, late talker. As evident by the literature review, the field lacks studies of sign-infused treatment studies conducted with children diagnosed as late talkers. Yet, the use of sign is often

recommended for these children to facilitate their expressive language abilities. Unlike children with DS, CAS, or ASD, most children who are late talkers are expected to talk eventually and be dismissed from treatment. In fact, 50-70% of late talkers no longer demonstrate communication disorders at age seven (Rice, Taylor, & Zubrick, 2008). Given this, treatment recommendations for late talkers vary across clinicians, with some recommending intervention, others recommending parent training to increase the child's exposure to language and the need to use language at home, and still others recommending a wait and see approach with a re-evaluation in 3- to 6-months (Yoder & Warren, 2001). With the first two recommendations, the use of signs by either the parent or clinician is often recommended. Given that late talkers are expected to eventually talk, the use of signs for this group of children may be best considered short-term.

Signs Used within Intervention by SLPs as Contrasted with Other Signed Systems

The signs used by SLPs when they are incorporated into AAC treatments or infused within an oral communication intervention are typically not reflected of a signed language system, such as BSL in the United Kingdom or American Sign Language (ASL) in the United States and Canada. BSL and ASL are languages characterized by hand movements and facial expressions that are used most often by Deaf communities (Valli, 2011). These languages encode different grammatical structures (e.g., time, topic, comment/verb) than English, and they have their own sentence structure, idioms, and verb endings. Most importantly, BSL, ASL and other signed languages are just as complex as oral languages (Valli, 2011). Also, as with other languages, different dialectal varieties of BSL and ASL exist as signers of these systems adapt their use based on their communities and identities (Lucas, Bayley & Valli, 2003).

Signs used by SLPs in AAC and sign-infused interventions are also not typically reflective of homesigns as defined and studied by Goldin-Meadow et al. (2015) and others.

Homesigns reflect a system of gestures that can be linguistic in nature (Goldin-Meadow, 2010). Homesigns are typically created and used by children who are Deaf but have hearing parents. They spontaneously use homesigns to communicate without being exposed to sign language (Tervoort, 1962). Even so, these homesigns are often stable in form, and they can include a personal lexicon and properties of hierarchical structure and syntactic recursion. According to Goldin-Meadow and others, these gestures differ from those of hearing adults and children who use gestures to augment oral linguistic system rather than serving as a linguistic system.

Signs used by SLPs in AAC and sign-infused interventions are also not typically reflective of Signed Exact English (SEE) or Pidgin Signed English (PSE). SEE is a type of sign system that offers a sign for every English word spoken (Kong & Ranganath, 2008). It includes signs for content words and functional words and is used mostly by children and adults with hearing impairment. PSE blends BSL or ASL signs and English, but the grammar reflects spoken and written English. With PSE, there is also not an equivalent sign for every word in English, as in SEE.

In contrast to these other signed systems, signs used by SLPs in AAC and sign-infused interventions are typically reflective of simple hand movements that encode the first words children may say when interacting with their families. In the United States, these signs can be made up by a parent, child, or SLP, or they can come from ASL, SEE, PSE, or the baby sign literature. Importantly, they are isolated signs that are not necessarily presented within signed sentences. However, when using sign in speech and/or language therapy there is a consideration of the child's motor skills (Ronski & Sevcik, 2005).

A Study of Sign-infused Intervention

To date, the most comprehensive study of a sign-infused intervention was conducted by Wright et al. (2012). In this study, the goal of the intervention was to teach spoken words and manual signs to toddlers with DS using a signed-infused intervention that they referred to as Words + Signs intervention. The participants were four children, aged 23 to 29 months. To be included in the study, the children had to have a diagnosis of DS, normal hearing and vision, English as the primary spoken language, an expressive vocabulary of fewer than 15 spoken words or manual signs, and the ability to imitate placement and action of hand movements as assessed by the Body Imitations section of the *Motor Imitation Scale* (Stone, Ousley, & Littleford, 1997). The children were recruited from a program that was training the children's parents to use Enhance Milieu Teaching (EMT). EMT encourages parents and clinicians to engage in joint attention with their child, follow their child's lead, and offer utterances that are contingent upon the child's nonverbal and verbal behaviors. Parent utterances are also kept short to model utterances for their child. However, parents did not receive parent-training in the use of signs or language intervention prior to or during this study and they were asked to refrain from using any signs at home during the study (Wright et al., 2012).

A multiple-baseline design was implemented across the four participants, and the intervention was based on EMT and Joint Attention, Symbolic Play, and Emotional Regulation (JASPER; Kasari, Freeman, & Paparella, 2006). Hampton and Kaiser (2017) define EMT as a conversation-based intervention that aims to teach language and communication skills to children who have an MLU under 3.50. JASPER is an intervention typically used for children with ASD and focuses on play, joint engagement, and social interaction. Given the complimentary social communication goals of EMT and JASPER, there is overlap in these

interventions, and in recent years, EMT has been blended with JASPER (Kasari, Freeman, & Paparella, 2006; Kasari et al., 2014; Hampton, & Kaiser 2017, p. 87). However, EMT is typically used for a much wider range of children such as late talkers, children with or at risk for language delays or disorders, children with cognitive delays, and/or children with ASD or, DS. Clinicians who provide EMT and JASPER often undergo extensive training to incorporate each of these techniques into an overall therapy plan. In the Wright et al. (2012) study, the researchers included a certified SLP doctoral student studying early childhood special education and an interventionist with seven years of experience as an early intervention outreach teacher and a service coordinator. Both clinicians were not fluent in sign language but had used sign in intervention previously.

Within the Wright et al. (2012) study, the JASPER strategies during the intervention sessions were teaching new play actions and play sequences by modeling and expanding play, which were determined by the child's interest. The EMT strategies used during the intervention sessions included: following the child's lead, responding to communication, mirroring, mapping, expanding, modeling, time delay, and prompting. Definitions of each of these behaviors can be found in many places (e.g., Kaiser & Wright, 2013; Yoder & Warren, 2002). In general, following the child's lead involves an adult following the child when he or she looks at an object in the room (e.g., if a child looks at a car, the adult would focus her attention and communication on the car). Responding to communication is when an adult responds to any behavior (e.g., eye gaze, pointing, vocalizing, talking) by a child that could be communicative in nature. Mirroring is when an adult copies the child's nonverbal action. Mapping is when an adult adds words or utterances to a child's nonverbal act, which offers the child a linguistic form(s) for the nonverbal behavior. Expanding a child's expressive language involves adding spoken words to something

produced by the child (e.g., if the child says *ball*, the adult could expand this utterance by saying *Big ball*). Modeling is when the adult produces spoken language while they interact with the child (e.g., adult says *The car is rolling* when rolling a car). Time delay is when an adult offers a child a choice and then waits for an extended time for a response from the child. Prompting is when an adult offers a child a directive to talk, such as *Say apple*. While each of these language facilitation strategies have been described for spoken language, they can be accomplished with signs or a combination of spoken language and signs, as was done in the Wright et al. (2012) study.

The Wright et al. (2012) study included a baseline phase and a ten-week intervention phase. All sessions were twice a week for 20 to 30 minutes. The baseline and intervention sessions took place in a pediatric therapy clinic room. There were also generalization sessions collected during the baseline and intervention phases. These were ten minutes in length and collected at the children's homes. During the baseline sessions, a clinician engaged in interactive play with a child, but she did not engage in the sign-infused intervention. During the intervention sessions, the clinician engaged in the sign-infused intervention and paired signs with her verbal communication at least 80% of the time to model sign-infused speech. Words and signs were chosen from the *MacArthur-Bates Communicative Development Inventories (Words and Gestures)* (CDI; Fenson et al., 2006), which was completed by the participant's parents. For each child, 32 words with a paired sign were chosen for use during the sessions; of these, 16 referred to objects, 13 referred to actions, and 3 were request words. Examples of some of the signs were for the concepts: *baby*, *car*, *water*, *open*, *wash*, *in*, *all done*, *my/mine*, and *want*. During the generalization sessions, parents played with the child as they typically would while playing with

toys or books. These sessions were used to assess if the children used signs while playing with their parents.

To evaluate the effectiveness of the sign-infused intervention, the authors measured the following dependent variables: percent of time in joint engagement and symbol-infused joint engagement, spoken word acquisition, and sign acquisition. Joint engagement and symbol-infused joint attention were difficult for the researchers to measure, and they could only collect these measures for three children. Nevertheless, for these three children, they coded the first ten minutes of baseline sessions and the first ten minutes of half of the intervention sessions, and results were positive. Specifically, the average percent of time the children spent in symbol-infused joint attention ranged from 0% - 5%, whereas, the average percent of time during intervention ranged from 0% - 34%.

Other results from the study were reported through tables and figures to show the total number of signs and words acquired by the children. Although each child showed different patterns of change, all showed a relationship between receiving the sign-infused intervention and their use of signs and spoken words. Table 1 summarizes some of the findings from this study. As can be seen, all children acquired some signs and words. For example, out of 14 words Jay learned, 9 of them were signed, 2 were spoken and then signed, 1 was signed then spoken, and 2 were spoken only. This contrasts with his baseline performance, where he produced only 1 sign spontaneously and no spoken words.

Table 1. Words Produced During Intervention

Child	Total	Signed Only	Spoken, then Signed	Signed, then Spoken	Spoken Only
Ryan	18	15	1	0	2
Erin	23	15	0	6	2
Jay	14	9	2	1	2
Gretchen	10	5	2	3	0

Summary and Research Questions

In summary, baby signs are recommended to parents to use with their typically developing children. However, there is not much evidence to support the claim that these signs lead to smarter children or children with stronger speech and language skills than others who are not taught signs. In contrast, within clinical practice, evidence supports the use of signs as an AAC option or as a therapy strategy for children who present with a variety of communication disorders. In addition, a recent study by Wright et al. (2012) provides compelling data to support the infusion of signs into oral communication interventions.

To expand upon this line of research and clinical practice, the current study was designed to examine a novice clinician's attempt to infuse sign into an oral communication intervention that was designed for a young child classified as a late talker. The intervention sessions were guided by procedures outlined in Wright et al. (2012). Also, to evaluate changes across time and the effect of the sign-infused intervention on the clinician and child, the researcher completed pre-intervention sessions and post-intervention sessions. The research questions guiding the study were:

1. What signs does the clinician use during the intervention sessions and are some signs used more than others?

2. Does the clinician's use of signs alter her spoken communication behaviors during the intervention sessions?
3. Does the child produce any of the signs in imitation or spontaneously during the intervention or post treatment sessions?
4. Does the child produce any new words or multi-word combinations during the intervention or post treatment sessions?
5. Does the child's use of signs alter her spoken communication behaviors during intervention and post treatment sessions?

CHAPTER 2. METHODS

The design of the experiment reflected a descriptive case study, and included a base-line phase, intervention phase, and post-intervention phase. Data were collected between July and September 2019. After institutional review board approval, caregiver consent, and child nonverbal assent, the researcher (who also served as the clinician) completed 18 sessions at the child's home (see Appendix A).

Participants

The researcher (who also served as the clinician) was a second-year graduate student, aged 22 years, in Communication Sciences and Disorders. Prior to attending graduate school, she learned and used ASL in a professional setting for five years, non-consecutively. She was also involved in the Deaf Community of Tallahassee, Florida and was a teaching assistant for ASL courses at Florida State University. Prior to the study, she had used strategies from both EMT and JASPER as part of a supervised clinical practicum with a toddler diagnosed with mixed expressive and receptive language delay. However, she had never used manual signs, baby signs, or ASL in her supervised therapy services.

The child was a female, aged 2;2 years, who was given the alias Rose. At the time of the study, the child was exposed to only spoken English at home and school and was the only child in the family. Both parents obtained a college degree and one parent completed a Master's degree. Prior to the study, the clinician and Rose's mother knew each other personally through work. It was through their personal relationship that Rose's mother verbalized concerns to the researcher about Rose's expressive language not being as developed as her peers.

At the start of the study, the researcher collected a case history from Rose's mother and administered the *MacArthur-Bates Communicative Development Inventories (CDI): Words and*

Sentences (Fenson et al., 2006). The case history revealed parental concern for Rose's expressive language abilities but not her receptive language abilities. In addition, Rose's history included bilateral pressure equalizer (PE) tubes inserted at 13 months following repeated ear infections, and these had been removed prior to the start of the study. Per parent report, Rose's vision, hearing, social, and behavioral history were all within normal limits. Rose also had just begun to use 2-word phrases (age 22 months), and she was understood by family and friends when she talked, but she preferred to use gestures, eye gaze, and single words to communicate. Per parent report, Rose rarely imitated others, said her name, or produced three-word combinations.

The *CDI: Words and Sentences* is a parent checklist that assesses the language and communication skills of toddlers, aged 16 to 30 months. Part I of the *CDI* documents the child's production and use of 680 words divided into semantic categories (e.g., sounds, toys, actions, household items). Part II analyzes early grammar, including understanding of word forms and the complexity of multi-word utterances. Heilmann et al., (2005) found the *CDI* to have validity in measuring children's language abilities using a sample of 100 children, aged 30 months. Specifically, their study found that the children with expressive language delays scored between 1-11% on the *CDI* and those presenting typical expressive language scored at or above the 49th percentile.

Rose's mother completed the *CDI* on April 13th, 2019. At that time, Rose produced 34 words out of the 680, putting her in the 10th percentile for her age for word production (see Table 2). This score identified her as having an expressive language delay because she fell under the 11th percentile (Heileman et al., 2005). However, Rose's mother also reported through the *CDI* that Rose could request objects that were not in the room, and she sometimes referenced past events or people and objects who were not present. She also had labeled an object as someone's

who was not present, but she had not talked about the future. On Part II of the *CDI: Words and Sentences*, Rose's mother reported that Rose did not use plural (-s), possessive (- 's), progressive (-ing), or past tense (-ed). Rose sometimes combined words (e.g., *no poo-poo, bye puppy*), and based on Rose's three longest utterances reported by her mother, her longest MLU was 2.0. The reported longest utterances were *no poopoo, beebee side* (bug outside), and *bye puppy*. This estimated MLU placed Rose in the 35th percentile, meaning that Rose's estimated MLU was below 65% of peers the same age.

Table 2. Words Rose Produced as Reported on the CDI: Words + Sentences

Words Rose Produced		
Allgone	Doll	Outside
Ball	Eye	Play dough (dough dough)
Bed	Grandma	Puppy
Bicycle (bike)	Grandpa	Red
Block	Green	Shoe
Blue	Hot	Slide
Bubbles	Ice cream	Tiger
Bug (bee bee)	Mommy	Tummy (belly)
Bye	Moo	Uh oh
Cookie	Moon	Yellow
Cup	Night	
Daddy	No	

Comprehension Measures

Two measures of Rose's receptive language abilities were collected, although it should be noted that these were collected after the study was completed. The two measures came from the *Receptive-Expressive Emergent Language Test – Third Edition* (REEL-3; Bzoch et al., 2003) and *The Preschool Language Scale – Fifth Edition* (PLS-5; Zimmerman, Steiner, & Pond, 2011).

The *REEL* is a parent report assessing a child's emergent receptive and expressive language. The receptive portion of this test was completed by Rose's mother on September 26th, 2019. The *REEL* yields standard scores that have a normative mean of 100 and a standard deviation of 15. Rose obtained a standard score of 118, which is 1.2 standard deviations above the mean. This score placed her in the 89th percentile, meaning she performed better than 89% of her same-aged peers. This score identified her as presenting above average receptive language abilities relative to peers the same age.

The auditory comprehension subtest of the *PLS-5* also was administered on September 26th, 2019 to assess Rose's receptive language abilities. The *PLS-5* yields standard scores that have a normative mean of 100 and a standard deviation of 15. Standard scores between 85 and 115 are considered within the average range and scores above 115 are considered above average. Rose earned a standard score of 118 which was 1.2 standard deviations above the mean and placed her in the 88th percentile for her age. Consistent with Rose's *REEL* score, Rose's *PLS-5* score indicated that her receptive language abilities were above the average range for her age.

Table 3. Rose's Preschool Language Scale – Fifth Edition (PLS-5) Scores

Subtest	Standard Score	Standard Deviation	Percentile
Auditory Comprehension	118	1.20	88

Design

Phases

Pre-intervention Phase. During the pre-intervention phase, which involved three sessions over the course of a week, Rose played with the researcher while the researcher engaged in oral communication therapy strategies. These strategies are described below. During these sessions, no signs were used by the researcher.

Intervention Phase. The intervention phase involved 12 sessions that were completed in four weeks. During the intervention sessions, the researcher continued to use oral communication therapy strategies, and she attempted to pair 11 different signs to her spoken words.

Post-intervention Phase. The post-intervention phase was conducted for 3 sessions across the course of a week. These sessions were identical to the base-line sessions as the researcher engaged in oral communication therapy strategies, but she did not produce any signs.

Materials Used in All Sessions

All sessions involved the researcher and child engaged in play with toys, a tub of water, and a towel to protect the floor if water spilled during play. A toy box was created to guide play and facilitate three different play themes. These were: washing household items, playing with toys, and taking care of a baby (see Table 4). Within each theme, there also were three activities which rotated across sessions in a fixed order. Each activity lasted ten minutes, resulting in thirty-minutes of play. An example of one week of sessions is as follows. On day one, play consisted of washing dishes, playing with cars and a parking garage, and feeding the baby doll. On day two, play consisted of washing cars, playing with farm animals on the farm, and putting the baby to sleep. On day three, play consisted of washing animals, playing with items for a castle, and changing the baby's diaper. As shown here, each week included three sessions with the same three themes and activities, with the orders of the activities fixed.

Oral Communication Therapy Strategies Used in All Sessions

Consistent with the JASPER/EMT strategies outlined by Wright et al. (2012), the toys for each theme were environmentally arranged so that they were in Rose's field of vision. Then following Rose's lead, the clinician focused her communication on the toy(s) of Rose's interest.

Table 4. Toys Used in Intervention.

	Activity 1 Toys	Activity 2 Toys	Activity 3 Toys
Washing	Dishes: toy pan, lid, knife, spoon, bowl, and mixing spoon, water, bucket, and towel.	Cars: four toy cars (yellow, purple, red, and orange), water, bucket, and towel.	Animals: toy farm animals including two pigs, two sheep, a chicken, a rooster, a frog, a horse, a cow, a puppy, and water, bucket, and towel.
Manipulables	Cars: parking garage, four toy cars (yellow, purple, red, and orange)	Farm: farm, toy animals including two pigs, two sheep, a chicken, a rooster, a frog, a horse, a cow, and a puppy.	Castle: toy castle, fairy, two ponies, two toy brushes, and toy fruit including an apple, orange, lemon, banana, and grapes.
Baby doll	Feeding: baby, bottle, and tub.	Sleep: baby, blanket, tub, robe, and diaper.	Changing: baby, blanket, tub, robe, and diaper.

Also, consistent with the JASPER/EMT strategies outlined by Wright et al. (2012), the oral communication therapy strategies included: following the child's lead, responding to communication, mirroring, mapping, expansion, modeling, time delay, and prompting. While following the child's lead, the examiner would play with the toys the same way the child was (e.g., pushing the cars down the slide). To respond to communication, the examiner would get a toy the child pointed to and give it to her or offer her a toy she was looking at. Mirroring involved engaging in play that mirrored Rose's play. For example, if Rose was pushing cars down the slide, the researcher would also begin pushing the cars down the slide. Mapping involved producing words and utterances to describe Rose's play actions. For instance, when Rose picked up the fairy and made her fly, the researcher said, *The fairy is flying*. Expanding involved adding words to Rose's spoken language productions. For example, Rose often said, *want it* when she wanted a toy. Each time Rose said this, the researcher would reply *You want*

the X, using the name of the toy Rose wanted. Modeling involved using utterances that were longer and contained more diverse vocabulary than Rose was currently producing. For example, while playing with the castle, the research would say, *Let's put the X in the castle*. Finally, time delay involved offering Rose two toys (e.g., two animals), and waiting for Rose's responses before giving her one. Table 5 provides example utterances that were produced during the play sessions. Finally, prompting involved questions and statements to prompt Rose to produce utterances. For example, the researcher would ask, *Do you want the car*, to prompt Rose to say *Want car*, or the researcher would ask, *What do we wash next*, to prompt Rose to say *Wash frog*.

Signs Used in the Intervention Sessions

Signs were chosen based on the play activities, and the age of acquisition of each word using the *CDI* normative data. The signs also were of words that were not yet in Rose's expressive word inventory per the *CDI*. For each play activity, the signs included one verb, noun, and preposition. The signs were: WATER, WASH, IN, TOY, WANT, DOWN, BABY, ON, KISS, MORE, and ALLDONE. The handshape and movement of the signs were chosen from the researcher's prior knowledge of ASL (see Appendix B). Table 5 lists examples of the planned play activity, planned utterances, and planned signs.

Table 5. Researcher's Planned Signs

Structured Play Activity	Planned Utterances	Planned Signs
Washing	I am washing the cars.	WASH (verb)
Dishes, Cars, Animals	Put the puppy in the water.	IN (preposition)
	The lid is in the water.	WATER (noun)
Manipulables	I am playing with a toy.	TOY (noun)
Parking garage/gas station with cars, farm & animals, setting up a castle, playing, picnic	You want the car.	WANT (verb)
	Car goes down the slide.	DOWN (preposition)
	The car slid down.	DOWN (preposition)
Babydoll	Kiss the baby goodnight.	KISS (verb)
Eating/feeding, putting the baby to sleep, changing the baby's diaper & dressing	The baby's robe is on.	ON (preposition)
	The baby is sleeping.	BABY (noun)
	Night-night baby.	BABY (noun)
All Play Activities	All done cars.	ALLDONE (verb)
	Let's get more animals	MORE (adjective)

Language Sample Transcription and Coding

All sessions were video and audio recorded with an iPad on a tripod stand. For blinding purposes, the video files of the sessions were labeled with random letters and stored in the Language Development and Disorders Lab at the researcher's university. The researcher and four undergraduate student assistants transcribed and coded the researcher and child's behaviors using Start-Stop Omniversal video transcription software and Systematic Analysis of Language Transcripts 18.0 software (SALT; Miller & Iglesias, 2018). Also, a coding system was created to indicate within the sample when the researcher or child produced a sign or combination of signs.

Each signed word received a code with brackets around it (e.g., alldone became [alldone] in SALT). Following Oetting et al. (2018), each session underwent three passes of transcription by at least two different people.

Reliability

Reliability of the transcription and coding was examined by having a second team of researchers transcribe and code a random three minutes of each session. Then, the original 3-minute transcripts were compared to the 3-minute reliability transcripts. This comparison allowed for a check of 10% of the transcription and coding of each session. After comparing the total number of utterances of the researcher and child from the original and reliability 3-min excerpts, the researcher's total utterances were on average 95.77% (range = 88.64% - 100%) similar across the two sets of excerpts. The child's total utterances were on average 91.86% (range = 82.14% - 100%) similar. After comparing the total number of words of the researcher and child from the original and reliability 3-minute excerpts, the researcher's total words were on average 98.71% (range = 93.91% - 100%) similar across the two sets of excerpts. The child's total words were on average 93.71% (range = 57.14% - 96.97%) similar. These levels of agreement indicated that the transcription and coding within the full samples were reliable.

CHAPTER 3. RESULTS

Preliminary Analysis

As a preliminary analysis, the pre- and post-intervention sessions were reviewed to determine if the researcher mistakenly produced any signs during these sessions. No signs by the researcher were observed. The pre- and post- intervention sessions also were checked for signs produced by Rose. No signs by Rose were observed.

Researcher

Signs Produced by Researcher During Intervention Sessions

During the 12 intervention sessions, the researcher produced 50 different signs for a total of 2,311 signs. Recall that only 11 different signs were planned. These 11 planned signs were produced but so were 39 additional spontaneous signs. Table 6 lists each of the planned signs produced in the order of their frequencies. Of the planned signs, BABY (noun) was produced most. The second most produced sign was WANT (verb). MORE was signed the least.

Table 6. Frequency of Planned Signs Across Intervention Sessions

Sign	Total
BABY	357
WANT	301
WATER	259
WASH	248
ON	235
DOWN	225
ALLDONE	162
IN	155
TOY	120
KISS	83
MORE	22

The researchers' spontaneous signs are listed in listed in Table 7. The most produced spontaneous sign was YOU, which was produced 40 times across the intervention sessions. The second most produced spontaneous sign was ME, at 21 times. Both are pronouns. As indicated in the table, many of the other spontaneous signs were produced at relatively low frequencies.

Table 7. Frequency of Spontaneous Signs Across Intervention Sessions

Sign	Total
YOU	40
ME	21
TWO	7
BYE	6
UP	5
EAT	4
NOT	4
OFF	4
OUT	4
WAKE	4
FOUR	3
HAND	3
MY	3
ONE	3
PLAY	3
ALL	2
BIG	2
HAVE	2
HEAD	2
THANKYOU	2
WHAT	2
APPLE	1
BALL	1
FISH	1
FLOOR	1

table cont'd.

Sign	Total
FROM	1
FULL	1
HORSE	1
HOT	1
LIKE	1
NEED	1
NOTHING	1
NO	1
OK	1
SHOES	1
SPOON	1
TIME	1
YELLOW	1
YOUR	1

Frequency of Signs by Classification

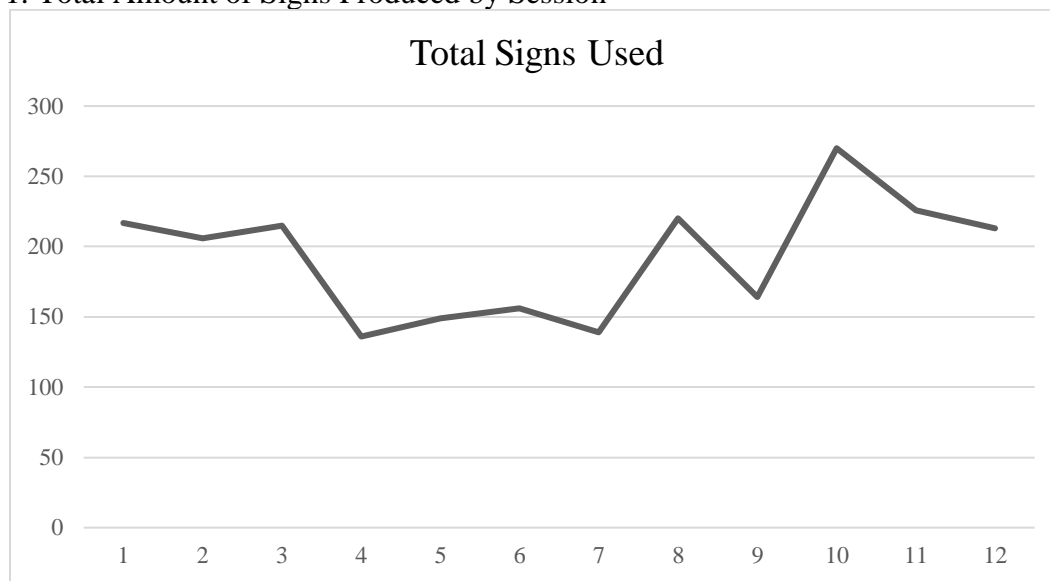
As indicated by Tables 6 and 7, the researcher produced signs from different word classes. This finding was not surprising as signs for nouns, verbs, and prepositions were planned. To examine the researcher's use of the signs by word class, all planned signs were coded for type (nouns, verbs, prepositions), with MORE and ALLDONE classified as adjectives. Spontaneous signs were also classified with a slightly larger class list: nouns, verbs, prepositions, pronouns, adjectives, queries, negations, and social. As shown in Table 8, prepositions were the most produced type of sign and occurred 89.86 times per session, which was followed by verbs at 80.90 and nouns at 57.63. Signs to query (e.g., WHAT) and to express negation (e.g., NO, NOTHING, NOT) were produced the least, at only 2 per session.

Table 8. Average of Signs Produced by Word Class

Word Classification	Sum	Mean	Standard Deviation
Verb	809	80.90	115.39
Noun	749	57.62	117.54
Preposition	629	89.86	110.61
Pronoun	67	13.40	17.01
Adjective	40	5	7.15
Query	2	2	
Negations	6	2	2.65
Social	9	3	2.65

Figure 1 presents the total amount of signs in each session. The total number of signs used in each session increased across sessions; however, there was a slight dip in signs produced in intervention sessions 4, 5, 6, and 7. During these sessions, Rose seemed uninterested in the toys and the researcher engaged in behavioral management techniques in these sessions more than in other sessions. This could be a reason that those sessions included less signs. The greatest number of signs the researcher produced was in session 10 and included 270 signs. The least number of signs the researcher produced was in session 4 and included 136 signs.

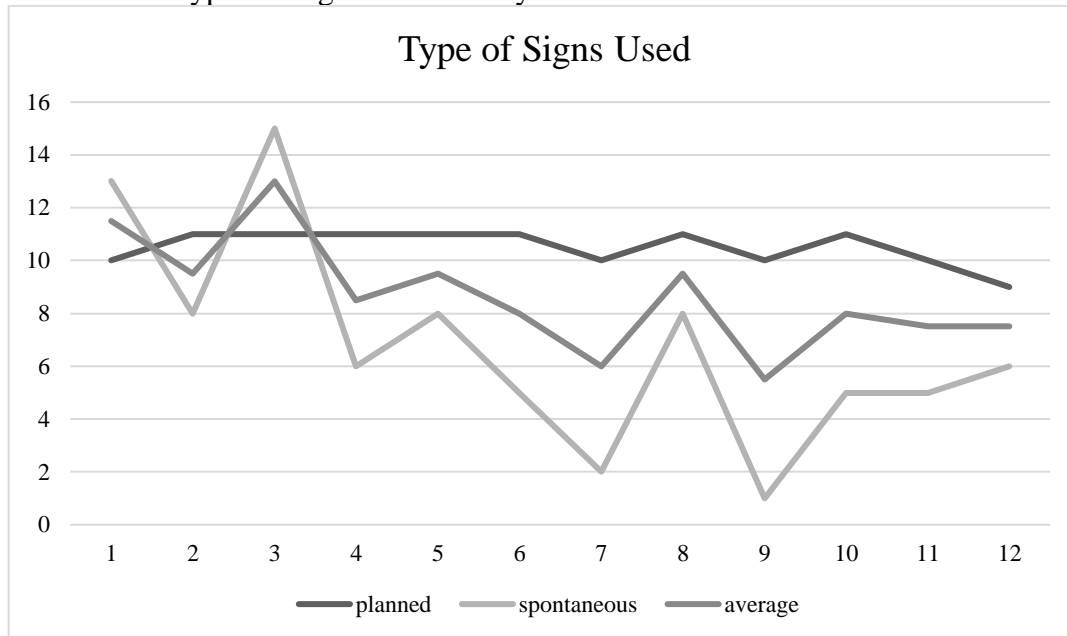
Figure 1. Total Amount of Signs Produced by Session



Type of Signs Produced by Intervention Session

The researcher's use of signs varied throughout the sessions. As shown in Figure 2, there was a general trend downward, indicating that the researcher produced a greater number of different signs at the beginning of the intervention and less at the end. The first session, the clinician produced 23 different signs, and the last session she produced 15. The greatest number of different signs produced was 26, and this occurred during intervention session 3. The least number of signs produced in one session was 11, and this occurred during intervention session 9. As also shown in Figure 2, patterns of change in the number of different signs produced by the researcher were tied to whether the sign was planned or spontaneous. Whereas similar numbers of different planned signs were produced across sessions, the number of different spontaneous signs decreased. By the last intervention session, the only spontaneous sign produced was ME, and the remaining 10 were planned.

Figure 2. Different Types of Signs Produced by Session



Planned signs averaged 197 per session, and spontaneous signs averaged 3.69 per session. Overall, the researcher produced the planned signs more than the spontaneous signs. This was expected as the planned signs were predetermined and their use by the researcher was the goal of the intervention. The spontaneous signs were unplanned. Table 9 shows that the researcher produced each planned sign every session, with the exceptions of ON in session 1, KISS in session 12, and MORE in sessions 7, 9, 11 and 12. KISS and MORE were also the researcher's two least produced signs as well. As also shown in the table, low frequency signs tended to be low frequency in all of the sessions, and the high frequency signs were high frequency in all sessions.

Table 9. Frequency of Planned Signs Produced by Session Number

Sign	1	2	3	4	5	6	7	8	9	10	11	12	Total
BABY	11	18	27	27	19	19	35	32	33	48	48	40	357
WANT	33	49	33	18	14	24	9	20	10	12	54	25	301
WATER	37	14	14	15	13	26	12	29	15	35	26	23	259
WASH	28	6	23	19	12	20	15	31	26	30	13	25	248
ON		19	37	10	15	15	17	26	20	31	17	28	235
DOWN	25	27	10	11	12	7	23	30	12	32	14	22	225
ALLDONE	14	23	23	7	10	8	10	10	20	12	15	10	162
IN	8	5	6	9	21	15	6	14	10	29	15	17	155
TOY	40	14	3	10	11	2	3	7	10	10	5	5	120
KISS	1	12	4	3	4	9	7	7	5	22	9		83
MORE	4	3	6	1	2	2		1		3			22

The spontaneous signs were produced less consistently than the planned signs by the researcher (Table 10). For example, many spontaneous signs, such as HEAD, THANKYOU, and SHOES, were produced in only one session. YOU was the most consistently produced sign, but it was not produced in sessions 7, 9, and 10. The second most frequent spontaneous sign, ME, was produced in half of the intervention sessions. By session 8, however, the researcher's spontaneous signs significantly decreased.

Table 10. Frequency of Spontaneous Signs Produced by Session Number

Sign	1	2	3	4	5	6	7	8	9	10	11	12	Total
YOU	2	8	6	1	6	4		2			1	10	40
ME			4		4	1			3		5	4	21
TWO			3		1					2		1	7
BYE			2	1				3					6
UP	1	2					1					1	5
EAT			1				1	2					4
NOT			2			2							4

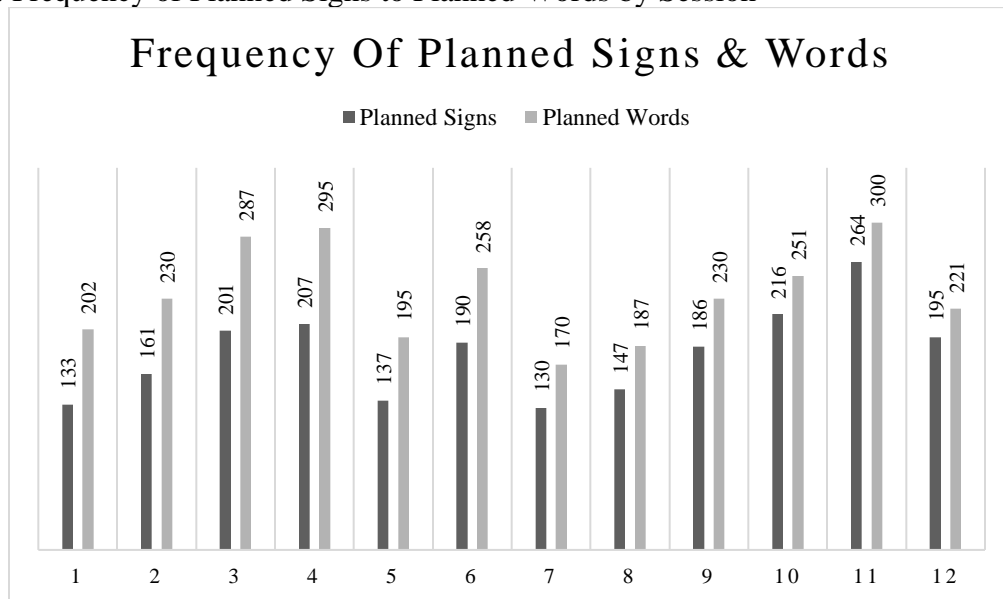
table cont'd.

Sign	1	2	3	4	5	6	7	8	9	10	11	12	Total
OFF								2		1		1	4
OUT					1			1			2		4
WAKE			1	1						1	1		4
FOUR	2				1								3
HAND		1		1	1								3
MY	2	1											3
ONE	1									1	1		3
PLAY		1	1	1									3
ALL	1					1							2
BIG			1					1					2
HAVE					1	1							2
HEAD			2										2
THANKYOU			2										2
WHAT	1			1									2
APPLE			1										1
BALL	1												1
FISH			1										1
FLOOR			1										1
FROM	1												1
FULL	1												1
HORSE		1											1
HOT												1	1
LIKE			1										1
NEED	1												1
NOTHING								1					1
NO					1								1
OK										1			1
SHOES		1											1
SPOON	1												1
TIME								1					1
YELLOW	1												1
YOUR		1											1

Frequency of Signs and Words

To examine the ratio of the researcher's signs to words, the total planned signs by the researcher was compared to the total planned words spoken by the researcher. The total percentage of planned signs to words across all sessions was 78.68% (2167 signs/2826 words). As seen in Figure 3, the highest percentage of planned signs to words was 88.24%, (195 signs/221 words) in session 12. The session with the lowest ratio was 65.84% (113 signs/202 words) in session 5. Therefore, the range in ratios was 65.84% to 88.24%. There were higher ratios in the last three intervention sessions (session 10 = 88%, session 11 = 86.06%, session 12 = 88.24%), so there was a general increase in the sign to word ratio over time.

Figure 3. Frequency of Planned Signs to Planned Words by Session



Researcher's Spoken Communication Behavior with Signs

To examine the researcher's spoken communication behaviors within the intervention sessions and across the three phases of the study, four of her spoken behaviors were examined: number of utterances, MLU, total words produced, and total different words produced (see Figures 4-7).

Figure 4. Researcher's Total Words

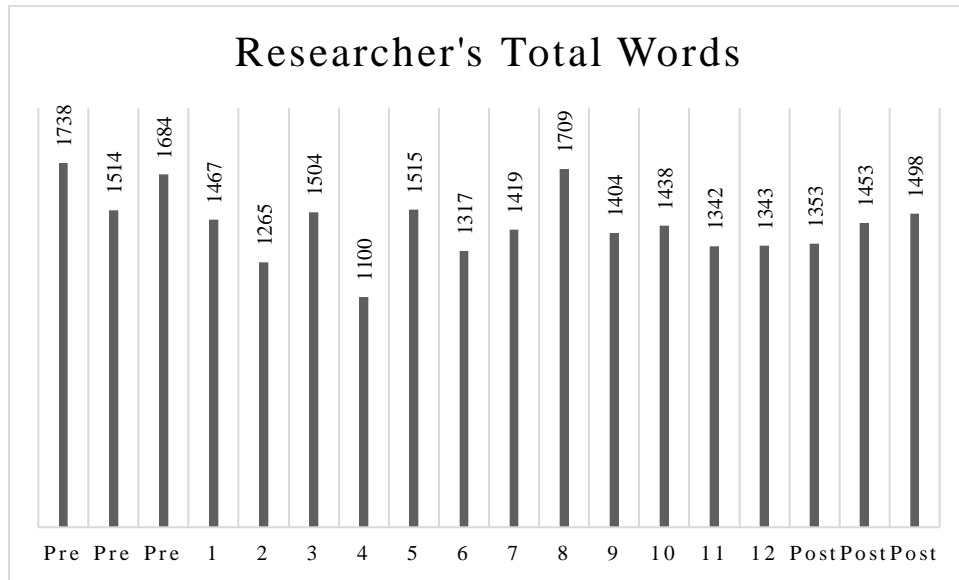
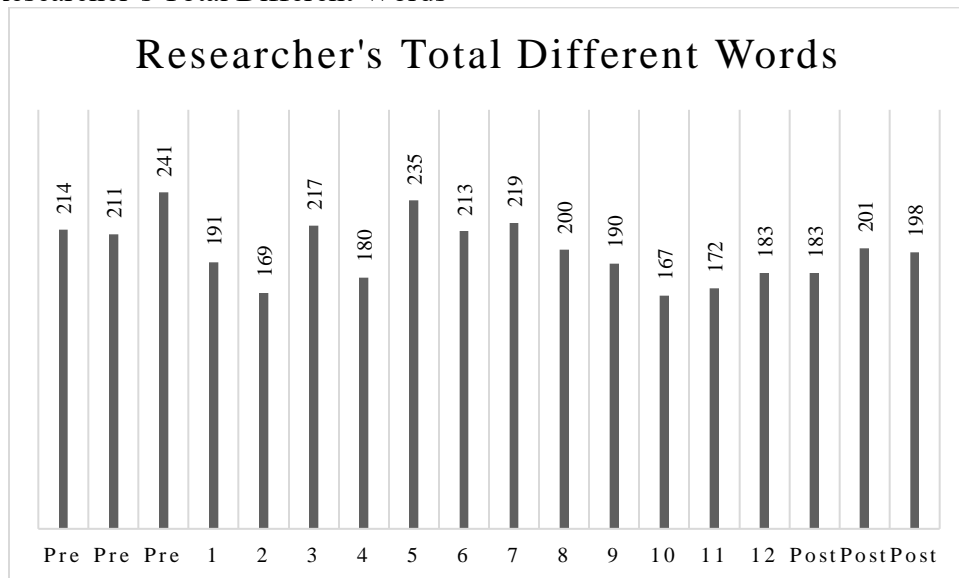


Figure 5. Researcher's Total Different Words



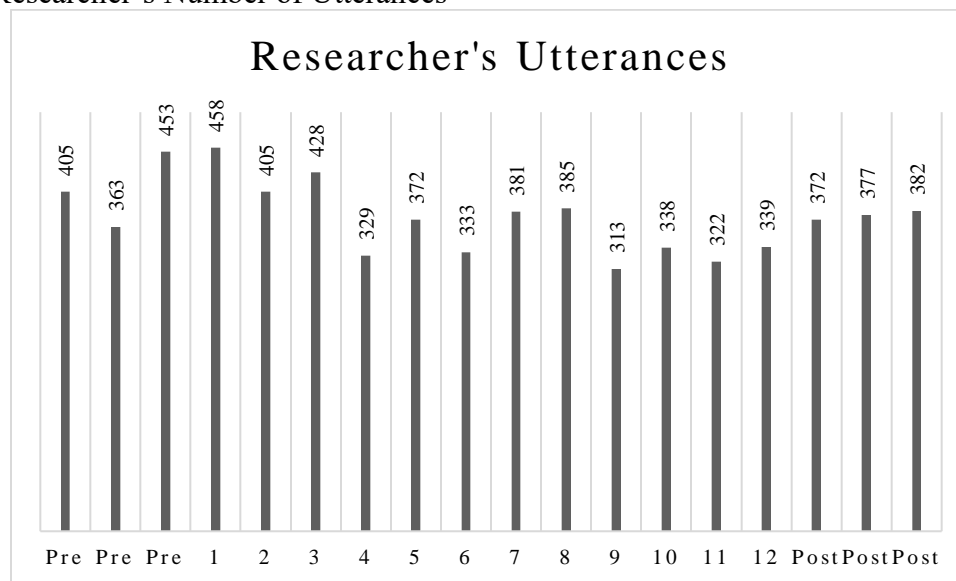
As seen in Table 11, the researchers' average number of utterances per session decreased from baseline and was lowest during the intervention sessions, when signs were used. The researcher's MLU in morpheme and total words produced also were lowest during the intervention phase when compared to the other two phases of the study. These findings indicate that the researcher spoke less and produced shorter utterances while producing signs. However,

the researcher's average number of different words produced was highest during the intervention sessions. This finding indicates that her use of signs led to her producing a more diverse vocabulary while using signs. To examine these data statistically, four one-way ANOVAs were completed, with study phase (pre-, intervention, post-) treated as a between-subjects variable. None of these analyses indicated that the differences observed in Table 11 were statistically reliable. This indicates that the signs did not lead to substantial changes in the researcher's spoken communication behaviors. Although visual inspection of the researcher's behaviors suggest that the use of signs led to changes in her behavior, these changes were not statistically reliable.

Table 11. Researcher's Spoken Language by Phase of Study

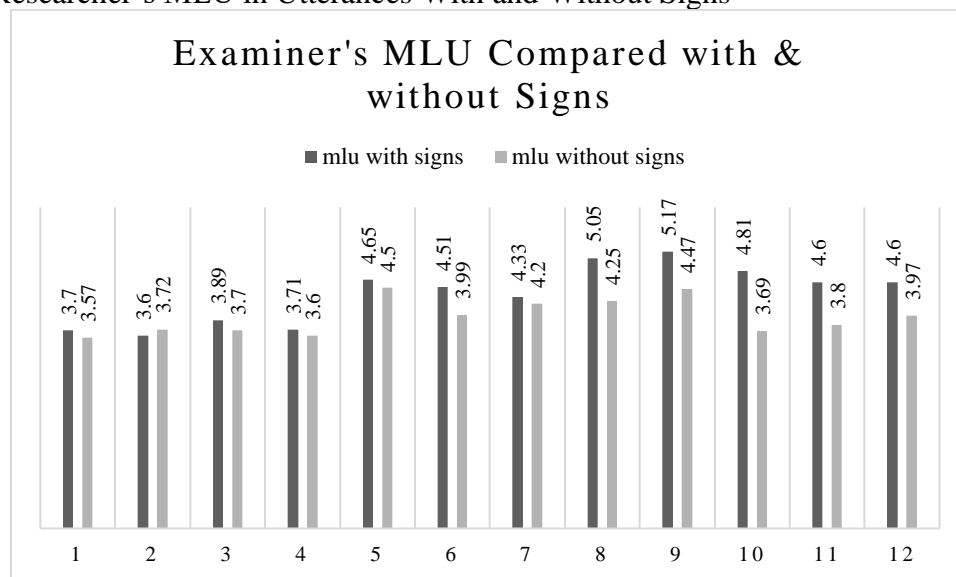
	Pre	Intervention	Post
Utterances	407 (45.03) 363-453	366.92 (45.88) 313-458	377 (5) 372-382
MLU	4.68 (.44) 4.18-4.99	4.39 (.54) 3.12-4.11	4.51 (.23) 4.26-4.71
Total words	1645.33 (116.90) 1514-1738	1401.92 (150.01) 1100-1709	1434.67 (74.22) 1353-1498
Total different words	222 (16.52) 211-241	294.67 (22.17) 167-235	194 (9.64) 183-201

Figure 6. Researcher's Number of Utterances



Finally, to better understand the effect of the researcher's signs on her spoken language behaviors during the intervention sessions, the researcher's MLU within utterances that included a sign were compared to her MLU in utterances that did not include a sign. As shown in Figure 7, the researcher's use of signs did not alter her MLUs significantly during the first few intervention sessions, but as the sessions progressed, the researcher's MLUs became longer in utterances with signs than in utterances without signs. This finding is interesting because it is the opposite of what was expected given that the researcher's average MLU was lowest in the intervention sessions.

Figure 7. Researcher's MLU in Utterances With and Without Signs



Child

Rose's Sign Production Across the Intervention Sessions

Recall that Rose did not use any signs during the pre-intervention sessions. To examine her sign use during the intervention and post-intervention sessions, the samples were searched for signs. Rose produced the sign WANT once during the 12 intervention sessions. This sign occurred in intervention session 11, and it occurred after the researcher modeled the sign and asked her if she wanted a toy.

Rose's Spoken Communication Behaviors

Although Rose only produced one sign during the sessions, her spoken language skills changed dramatically. As shown in Table 12, Rose's utterances and total number of words increased from the pre-intervention sessions to the post-intervention sessions. Her MLU in morpheme and total number of different words also increased from the pre-intervention sessions, and they were highest during the intervention sessions, when signs were produced by the researcher.

In fact, by the first intervention session with signs, Rose began producing many of the target signs as spoken words. These included: *baby, want, water, wash, down, alldone, toy, and more*. The prepositions *on* and *in* were not used by Rose, and the word *kiss* was produced later in the intervention sessions. Also, Rose often produced these target words in isolation or in multi-word combinations. Examples of her multi-word utterances with these target words included: *yeah alldone, night night baby, yeah want it, yeah more water, and I want the puppy*. Most often, Rose produced the target words following the researcher's model of an utterance that included one of the words, whether the word was signed or spoken. Rose also began to name toys such as *pig* and *car* during sessions without a prompt or model. Some words she produced were the target words and some were not, but most words she acquired were high frequency words that were produced by the researcher and supported by the play themes. Finally, during the intervention sessions, Rose began using adjectives with nouns to describe objects (e.g., *purple car*), plurals (e.g., *animals, cars*), and present progressive -ing with verbs (e.g., *crying, washing*).

Table 12. Rose's Spoken Language by Phase of Study

	Pre	Intervention	Post
Utterances	119 ^a (39.15) 82-115	190.33 ^b (37.59) 128-256	207 ^b (33.15) 180-244
MLU	1.29 ^a (.17) 1.13-1.46	1.70 ^b (.09) 1.56-1.88	1.55 ^c (.08) 1.48-1.64
Total words	87.67 ^a (37.07) 52-126	168.75 ^b (55.19) 85-255	194.67 ^b (45.52) 150-241
Total Different words	28 ^a (6.25) 23-35	50.08 ^b (11.66) 27-72	48.67 ^b (3.22) 45-51

Note: Different letters indicate a significant difference in the means.

To examine Rose's data statistically, four one-way ANOVAs were completed with study phase treated as a between subject variable. These analyses indicated that Rose's spoken language behaviors changed across the three study phases: number of utterances $F(2,15) = 5.263$, $p = .019$, $\eta^2 = .412$, MLU in morphemes, $F(2,15) = 18.08$, $p < .001$, $\eta^2 = .711$, total words, $F(2,15) = 3.75$, $p = .048$, $\eta^2 = .33$, and total different words, $F(2,15) = 5.61$, $p = .015$, $\eta^2 = .428$. To further explore these main effects, LSD post hoc t-test analyses were completed. These analyses showed that Rose's spoken language behaviors within the intervention and post-intervention sessions were significantly higher than her behaviors in the pre-intervention sessions. In addition, Rose's average MLU during the intervention sessions was significantly higher than her MLU in the pre- and post- intervention sessions. These findings show that Rose's expressive language skills increased as the sessions progressed.

To illustrate Rose's growth, Figures 8-11 presents her behaviors by sessions. The same pattern is found for all four measures. Rose's number of utterances, MLU, total words, and total different words all increased from the first pre-intervention session to the last post-intervention session. The most utterances Rose produced in a session was 256, and this occurred during intervention session 7. Her lowest number of utterances was 82, and this occurred during a pre-intervention session. It should also be noted that Rose's MLU (Figure 9) was highest during intervention session 12 but decreased once signs stopped being produced.

Figure 8. Rose's Utterances

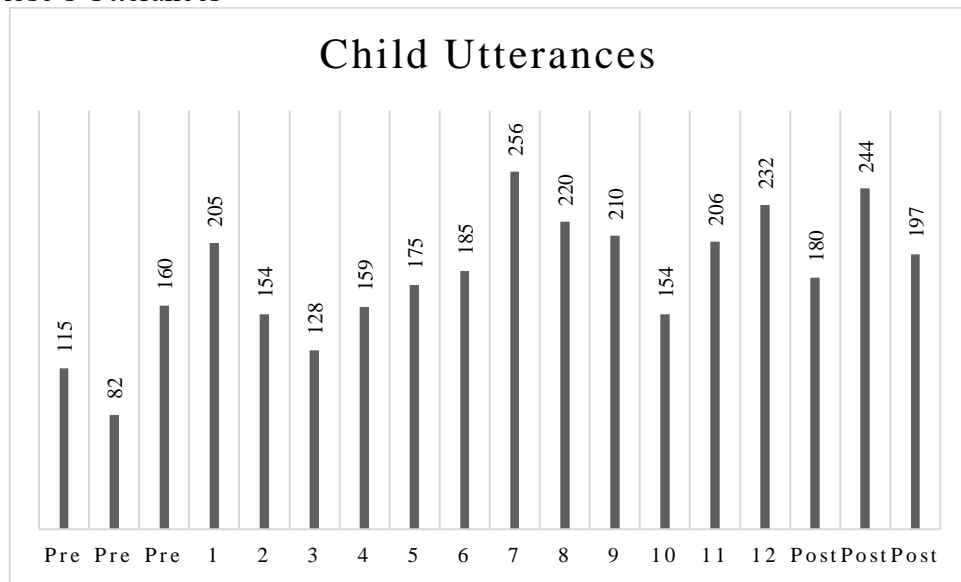


Figure 9. Rose's MLU

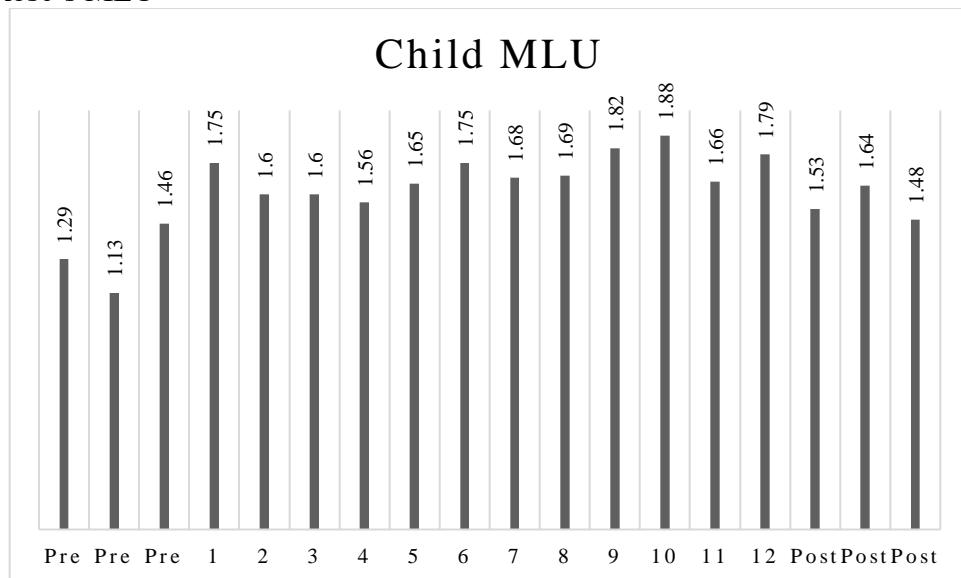


Figure 10. Rose's Total Words

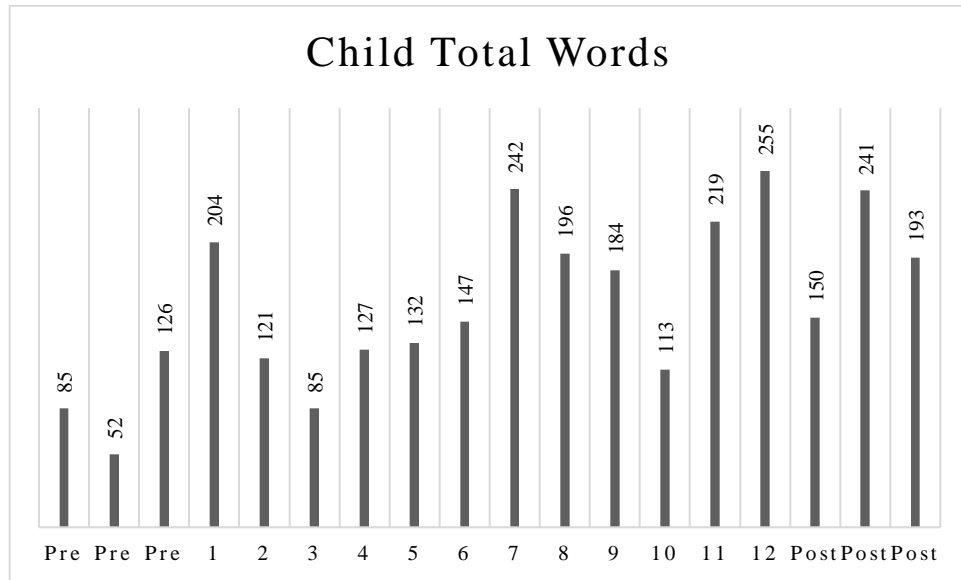
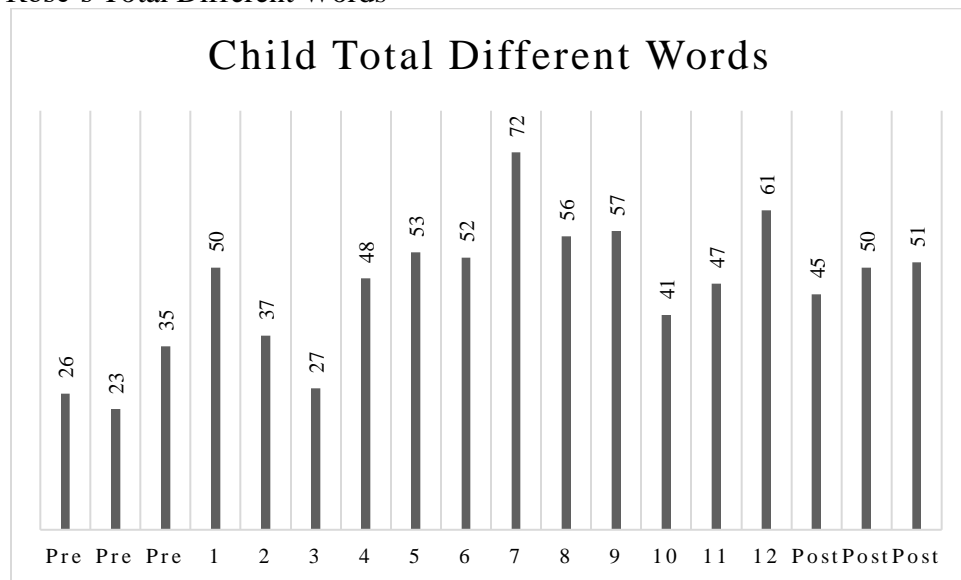


Figure 11. Rose's Total Different Words



Rose's CDI Results

Rose's mother completed the *CDI* a second time, on September 3rd, 2019, which was after the post-intervention sessions. This *CDI* indicated that Rose's expressive vocabulary increased by 128 words from her first *CDI*. Interestingly, Rose's mother reported that she produced the words *water*, *in*, and *on*, but not *baby*, *want*, *wash*, *on*, *down*, and *toy*, and these

were all targeted during the intervention. Her mother also did not report that she produced *more* and *alldone*, but these are not on the *CDI*.

Table 13 provides a comparison of Rose’s results from her two CDIs. As can be seen, post-intervention, Rose performed as well or better than 15% of her age-matched peers, and she was producing longer utterances (e.g., *mommy no fit*, *mommy happy*, and *I did it*). Rose’s mother also reported through the *CDI* that Rose was beginning to use word endings, such as plurals and possessive morphemes. Per her mother’s report, Rose’s MLU increased from 2 to 2.67. Post intervention, Rose even added irregular verbs into her inventory (e.g., *I did it*), and she began to use many words from the same semantic categories that were spoken and/or signed in the sessions, such as animals (e.g., cow, horse, pig), vehicles (e.g., car, truck), clothing (e.g., diaper, sock), items (e.g., blanket, brush, towel), and verbs (e.g., eat, go, kiss, play, splash). Rose also began producing pronouns such as *me*, *mine*, *I*, and *you* and prepositions such as *in*.

Table 13. Rose’s CDI Scores Pre- and Post-Intervention

	CDI Pre-Intervention		CDI Post-Intervention	
	Raw Score	Percentile	Raw Score	Percentile
Words Produced	34	10	162	15
Word Forms	0		0	
Word Endings	0		2	
Morpheme length of child’s 3 longest sentences (M3L)	2		2.67	
Complexity	0		10	
3 longest sentences examples	<i>no poopoo beebee side bye puppy</i>		<i>mommy no fit mommy happy I did it</i>	

CHAPTER 4. DISCUSSION

Although there is limited evidence to support the claim that baby signs lead to children with more intelligence or stronger speech and language skills than others who are not taught signs, signs are often recommended to parents to use with their typically developing, hearing children. In contrast to this line of work, evidence does exist to support the use of signs as an AAC option or as a therapy strategy for children who present with a variety of communication disorders. The current study was designed to learn more about sign-infused oral interventions by examining a novice clinician's attempt to infuse sign into an oral communication intervention for a toddler categorized as a late talker. The design of the study included three phases: pre-intervention, intervention, and post-intervention phases, the clinician was the researcher, and the intervention sessions were guided by those outlined in Wright et al. (2012). There were also four research questions guiding the study. These questions focused on the researcher and child's use of signs and their spoken language behaviors during the three phases of the study. The findings are summarized below.

Researcher

Over the 12 intervention sessions, the researcher produced 50 different signs for a total of 2,311 signs. The researcher also produced all 11 planned signs in the intervention sessions. In fact, the average number of planned signs per session was relatively high at 197. BABY was the most produced planned sign, whereas MORE was the least produced planned sign. The researcher also produced 39 different spontaneous signs. These signs were not planned, and until the researcher watched the videos, she was unaware of the many types and frequency of these signs. Nevertheless, the researcher's frequency of the spontaneous signs was relatively low at less than 4 signs per session; these signs also decreased as the sessions progressed.

The researcher's total number of signs increased as the sessions progressed. Although the researcher was successful in producing the signs at high frequencies, she still said the target words more often than she signed them. Specifically, the overall ratio of target signs to target words was 78.68%, and across sessions, the ratio ranged from 65.84% to 88.24%. This ratio is similar to what was reported in Wright et al. (2011). Of the different classes of signs, the researcher produced the target signs for verbs the most, with signs for nouns and prepositions following in frequency. Finally, even though the researcher added signs to the sessions, her spoken communication behaviors did not change.

Child

Rose only signed WANT once throughout the sessions, but her spoken communication behaviors increased. She produced most (9 out of 11) of the target words, and she produced them both in isolation and in multi-word utterances. Rose's number of utterances, MLU in morphemes, total words, and total different words also were significantly higher when the pre-intervention sessions were compared to the intervention and post-intervention sessions. Rose's mother also completed the *CDI* a second time, post-intervention, and the results showed that Rose added 128 words to her expressive vocabulary and increased her MLU .7 morphemes since the onset of the study.

Limitations

There was a number of limitations to this study. Most importantly, given that Rose received both signs and oral language intervention and there was no control participant or control targets, it is unknown whether her gains were related to the researcher's use of signs, the researcher's use of spoken language, other aspects of the intervention, or Rose's development of language, irrespective of the intervention.

Recall also that the goal of the study was to learn more about a novice clinician's use of signs during an oral language intervention for a late talker. Given this, the sessions progressed as planned without making modifications to the play themes, targeted words and signs, or the researcher's behaviors. While this decision added experimental control to the study, it did not allow for adjustments that could have led to more sign usage or more spoken language behaviors by Rose. For example, early in the intervention sessions, the researcher found it difficult to sign within the manipulable play theme because it was less structured than the washing and baby doll play themes. Also, the researcher would have discontinued the spontaneous signs more quickly or added them as targets if adjustments would have been allowed. Additionally, the researcher could have reduced her number of utterances when signing and/or used hand-over-hand techniques to encourage Rose to produce the signs. Finally, some of the signs were not ideal. TOY was signed only 120 times and it was the third least used sign; this may have been because the word TOY did not allow the researcher or child to talk about a specific toy. The signs for prepositions also could have been created to allow for opposites (e.g., ON/OFF, UP/DOWN) so that the researcher could have used them to offer the child a choice as she did orally during the intervention.

Another limitation related to the video recording. The video recording of the sessions was from only one angle, and often Rose's back was to the camera. This made it difficult for her signs to be recorded. Although not part of the study, the researcher kept a journal to log her observations about the sessions. Within the journal, the researcher noted a few more signs Rose used, but these were not captured on the video recordings. Through the journal, the researcher also noted that Rose usually produced a sign while speaking the same word (e.g., *yeah want it* and *I want it*). Again, these observations were not captured on the video recordings.

Future Research

Future research is needed to learn more about sign-infused oral interventions. This study was unique in that the clinician/researcher was proficient in ASL. Perhaps this is why she produced a number of spontaneous signs and why her spoken language behaviors did not change when she added signs to her utterances. Although not analyzed, the researcher also combined signs and this also was likely related to her being a user of ASL. Future studies are needed to examine different novice clinicians to see if their use of sign-infused intervention would be similar to the current researcher's.

A future study could also compare a sign-infused intervention to other interventions designed specifically for late talkers. As an example, Alt et al. (2019) created an intervention called Vocabulary Acquisition and Usage for Late Talkers (VAULT). Like the intervention in the current study, the VAULT intervention was play-based; however, this intervention focused on the adult producing a set of target words at high frequencies (i.e., 270 times in a non-telegraphic grammatical utterance) in a variety of linguistic and physical contexts, and children were not required to talk. In the Alt et al. (2019) study, the participants were 24 late talkers, aged 25 - 41 months, and the design included three baseline sessions, and then 16 30-minute sessions twice a week for eight weeks. At post-test, the *CDI* was also administered along with other tools. Results showed that the participating children learned more target words than control words. In the future, it would be interesting to examine which of these two interventions lead to greater or faster language gains in late talkers.

Conclusions

These findings indicate that novice clinicians who know sign can implement a sign-infused language intervention with late talkers and that this intervention can lead to positive

gains in the child's language abilities. Based on the current findings, novice clinicians engaged in sign-infused interventions may also expect their use of signs to increase as sessions progress and find signs for verbs to be easier to incorporate into sessions than signs for other word types, especially if the same play themes used in the current study are implemented. Careful planning of the clinician's signs, spoken language, and play themes may also play a role in what types of signs are easiest to incorporate into sessions. Finally, novice clinicians should not be surprised if sign-infused oral interventions lead to increased spoken language rather than increased sign use when working with late talkers. In fact, clinicians may want to use the findings of the current study to show parents the benefits of signs for increasing late talkers' spoken language development.

Appendix A

ACTION ON PROTOCOL APPROVAL REQUEST



Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu
lsu.edu/research

TO: Janna Oetting
Communication Sciences and Disorders

FROM: Dennis Landin
Kinesiology

DATE: July 3, 2019

RE: IRB# 4242

TITLE: Research to practice: Implementing sign infused intervention as a novice clinician

New Protocol/Modification/Continuation: New Protocol

Review type: Full ☐ Expedited ☒ **Review date:** 6/13/2019

Risk Factor: Minimal ☒ Uncertain ☐ Greater Than Minimal ☐

Approved ☒ **Disapproved** ☐

Approval Date: 7/2/2019 **Approval Expiration Date:** 7/1/2020

Re-review frequency: (annual unless otherwise stated)

Number of subjects approved: 10

LSU Proposal Number (if applicable):

By: Dennis Landin, Chairman 




PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –

Continuing approval is **CONDITIONAL** on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc.**

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at <http://www.lsu.edu/irb>*

Appendix B

WATER	
WASH	
IN	

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VITA

Loren Ann Stoller, from Boca Raton, Florida, graduated from Florida State University with a Bachelor of Sciences in Communication and Sciences Disorders in May of 2018. At Florida State University, she was the president of the American Sign Language (ASL) Honor Society, where her passion for ASL flourished. She anticipates earning her master's degree from Louisiana State University in May of 2020. Following earning her master's degree, she will work as a Speech-Language Pathologist Clinical Fellow with children.